5.0 Air Monitoring

5.1 Introduction

Air monitoring and emissions assessments have been performed at the Site since the Site began operations in the early 1950s. The Site has historically been subject to 40 CFR 61, Subpart H which specifies radionuclide air emissions limitations and monitoring requirements for DOE facilities. However, following decommissioning and environmental restoration activities pursuant to the RFCA (CDPHE et al, 1996), completed in Fall 2005, the remaining DOE-retained lands are no longer a "facility" as defined in 40 CFR 61.91(b); consequently, 40 CFR 61, Subpart H, no longer applies.

Compliance with the 10-millirem (mrem) standard had been determined by comparing environmental radionuclide air concentration measurements at specified air monitoring locations around the perimeter of the former BZ with the "Concentration Levels for Environmental Compliance" listed in Table 2 of Appendix E to 40 CFR 61. Compliance is demonstrated when each measured radionuclide air concentration is less than its corresponding compliance level in Table 2 and when the fractional sum of all radionuclides is less than one. In the period since September 2005, the air concentrations have been compared to the same benchmarks as a matter of comparison to a historical threshold. For the annual period from October 2005 to September 2006, the maximum contribution from any single isotope was less than 0.8 percent of the corresponding concentration level for environmental compliance and the fractional sum of all radionuclides was less than 1.5 percent of the allowable annual dose rate at the sampler with the highest fractional sum (sampler S-132). The average dose rate measured in CY 2006 was 0.82 percent of the 10 mrem standard, compared to the dose rate in CY 2005 of 2.75 percent of the standard for the 9 months of active demolition and other physical completion activities. CY 2005, as a whole averaged 2.27 percent of the standard.

In CY 2006, airborne radionuclides were dominated by U isotopes. This has been observed generally in previous years, the isotopes being almost entirely of natural origin. Across all compliance samplers, U isotopes characteristic of naturally occurring U contributed an average of 94 percent of the dose rate.

In October 2006, following a year of continuous monthly sampling and observation, routine analysis of air monitoring filters has been suspended at all three sampling locations. The samples from two of the locations (S-136 and S-138) are still collected on a continuous monthly sampling schedule, but are archived pending review of site activities and identification of possible soil disturbances that are potentially able to cause significant air emissions. During the past year, except for U, the measured isotopes were generally below their detection limits and not measurable. In the absence of large-scale soil disturbances, potential air emissions from the site would be expected to remain near or below their detection limit in the samples and would not be measured.

5.2 CY 2006 Air Emissions Source Description

Potential air-emitting activities involving radioactive materials at the Site during CY 2006 were quite limited. The most significant activities involve minor dirt-road regrading and construction, excavation at the SPPTS to perform adjustments and maintenance, and driving on these same

roads to perform various surveillance activities and minor Site maintenance. In addition, on March 2, 2006, a grass fire in the former BZ caused significant smoke emissions, with some potential to increase radionuclide air emissions due to particles that may have been attached to the leaves of plants and due also the removal of surface vegetation that protects the soil surface from wind erosion. Surface soil emissions are the prominent source of air emissions from the Site, and result from nonpoint, diffuse sources, including mechanical and natural disturbances of contaminated soil and debris. The remaining minor radionuclide air emission potential is the result of residual contamination from past radioactive material spills and other releases. All of these sources have been reduced to low levels with no extensive areas in excess of 50 pCi/g in soils near the surface. In addition to these contaminants, the soils on and around the Site contain quantities of naturally occurring radionuclides.

5.3 Air Monitoring for Radionuclides

This section describes the routine air monitoring performed at the Site since October 2005.

Historically, the Site demonstrated compliance with the 10-mrem public dose standard in 40 CFR 61, Subpart H, through emission measurement or estimation and dispersion modeling of Site emissions to determine the dose to the most impacted off-Site resident. Beginning with CY 1998, the Site transitioned to an approved alternative compliance demonstration method based on environmental measurements (ambient air sampling), as allowed by 40 CFR 61.93(b)(5). The monitoring conducted in CY 2006 conformed to that same methodology but is no longer used to demonstrate compliance.

5.3.1 Description of Sampling Network

The Site operated a network of three high-volume, size-fractionating ambient air samplers located at the perimeter of the site, one to the west on Highway 93 and two along Indiana Street. The sampling network is shown in Figure 5–1.

The two locations on Indiana Street (S-136 and S-138) are downwind of the Site under prevailing higher speed winds and in locations where typically the highest potential dose would be expected to occur from wind-eroded Site sources, based on modeling using representative meteorological conditions. These two downwind locations are those that would be appropriate to measure Site emissions based on the alternative compliance demonstration guidance given in EPA's *Guidance on Implementing the Radionuclide NESHAPs* (EPA 1991) under conditions of continuous fugitive dust emissions as are anticipated. The third location to the west of the Site (S-132) is predominantly upwind and is known to not be representative of Site emissions alone due to a significant contribution of natural U and its progeny from wide-spread sand and gravel mining operations immediately east and southeast of the sampling location. During periods of daytime upslope wind conditions impacts have been historically observed at this location from intense soil disturbance activities at the Site.

The ambient air samplers continuously collect both fine and coarse particulate matter fractions on filters and removable impactor surfaces that were exchanged and analyzed on a monthly schedule through September 2006. The samples were analyzed for the Pu, Am, and U isotopes that represent most of the radioactive materials handled at or residing on the Site. These isotopes account for all materials that have the potential to contribute 10 percent or more of the dose to the public.

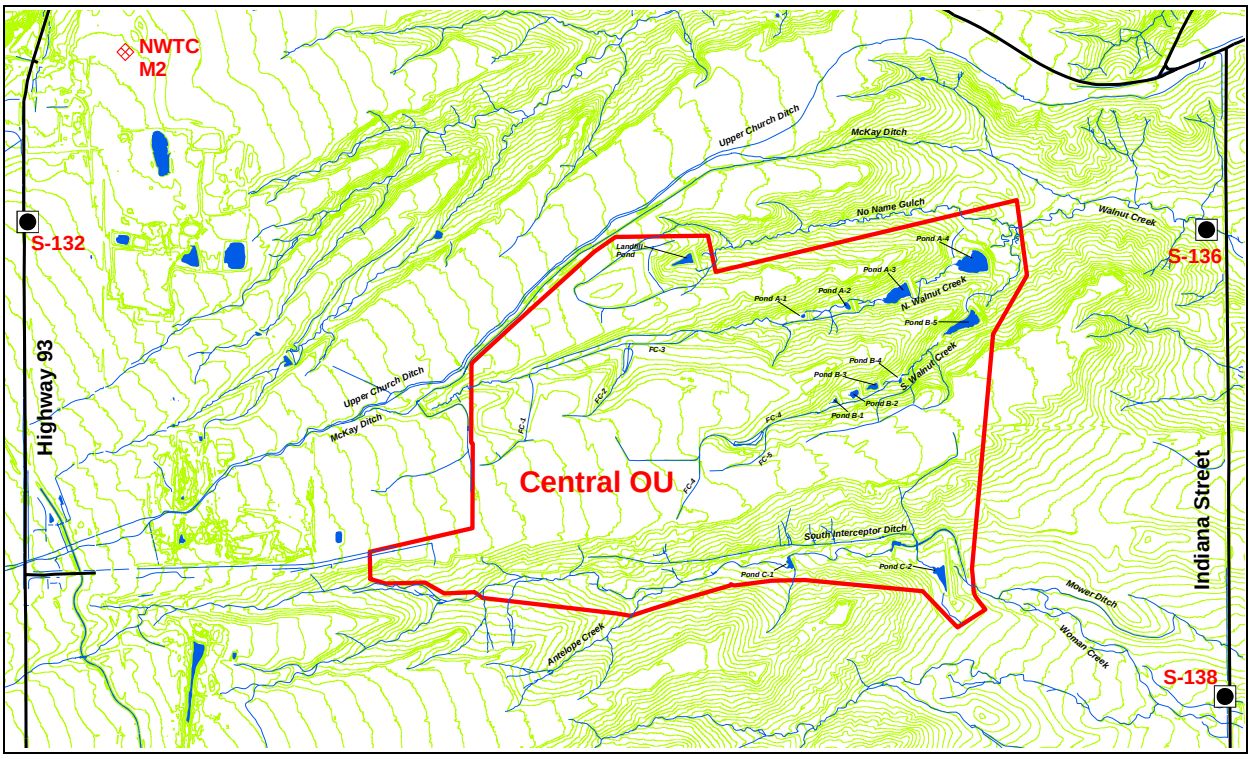

Figure 5–1. CY 2006 Air Sampling Network

5.3.2 Sampling Network Measurements in CY 2006

Filters from the sampling network were generally exchanged monthly through September 2006, then analyzed for Pu-239/240, Am-241, U-233/234, U-235, and U-238 on a regular submittal schedule. In April 2006, the filters from March were submitted for expedited analysis due to the grass fire that occurred in the former BZ. Other than that event, all filters were exchanged and analyzed on a prescribed schedule.

Average isotopic concentrations have been calculated at each sampler location from monthly measurements of isotopic activity on the filters and impactor pads, and from sample volume data. The average isotopic concentrations averaged over the period from October 2005 through September 2006 are shown in Table 5−1 for each sampler location. The results can be compared to the allowable concentrations of those same isotopes, if no other is present, or to the fractional sum of isotopes when a mixture is present as at the Site.

Table 5−1. Annually Averaged Isotopic Concentrations at Sampling Network Locations for the Period from October 2005 through September 2006

Sampler and Time Period	Am-241 (pCi/m^3)	Pu-239/240 (pCi/m^3)	U-233/234 (pCi/m^3)	U-235 (pCi/m^3)	U-238 (pCi/m^3)	Fractional Sum
S-132: 10/05-9/06	2.5E-07	6.4E-07	3.0E-05	1.5E-06	2.8E-05	8E-03
S-136: 10/05-9/06	5.8E-07	2.8E-07	1.4E-05	1.1E-06	1.6E-05	4E-03
S-138: 10/05-9/06	-7.4E-08	2.7E-07	1.6E-05	8.9E-07	1.8E-05	4E-03
Compliance Level (pCi/m^3)[a]	**1.9E-03**	**2.0E-03**	**7.7E-03**	**7.1E-03**	**8.3E-03**	**1**

[a]Compliance levels are listed for each isotope in Table 2 of Appendix E to 40 CFR 61.

Notes:
Am = Americium
Ci/m^3 = Curies per cubic meter; 1 Ci = 3.7×10^{10} Becquerel (Bq)
E# = $\times 10^{\#}$
Pu = Plutonium
U = Uranium

The *fractional sum* has been calculated for each sampler location by dividing each September 2005 through September 2006 isotopic concentration by that isotope's corresponding *compliance level* as listed in Table 2 of Appendix E to 40 CFR 61, then summing the fractions.

Table 5−2 lists the annually averaged concentrations of the individual isotopes. Both the fine particle concentrations (inhalable fraction) and the total airborne concentrations are listed. The total concentration is used for reporting dose consequences even though this is likely to result in a relatively large overestimate of the potential dose rate. The table shows that the fine concentration of each isotope is less that the total by a noticeable margin, except possibly when measurement error is most dominant. Results for Am and Pu were below detection limits in almost all samples.

Table 5−2. Annual Average Ambient Radionuclide Concentrations

Location	Analyte	Approximate Annual Average Concentration[a]	
		Fine Concentration (pCi/m^3)	Total Concentration (pCi/m^3)
S-132	Am-241	-8.01E-08[b]	2.48E-07
	Pu-239/240	3.21E-07	6.41E-07
	U-233/234	1.30E-05	2.96E-05
	U-235	7.48E-07	1.54E-06
	U-238	1.27E-05	2.82E-05
S-136	Am-241	-1.14E-07[b]	5.79E-07
	Pu-239/240	6.86E-08	2.79E-07
	U-233/234	6.77E-06	1.38E-05
	U-235	6.41E-07	1.06E-06
	U-238	8.93E-06	1.59E-05
S-138	Am-241	2.49E-07	-7.37E-08[b]
	Pu-239/240	-8.28E-08[b]	2.73E-07
	U-233/234	8.06E-06	1.64E-05
	U-235	2.98E-07	8.92E-07
	U-238	1.03E-05	1.82E-05

Notes: [a]Average Concentrations for Am are estimated due to loss of fine filters in March.
[b]A negative result indicates analytical results similar to the variability in the blank filter value (i.e., very low non-detectable results)

5.3.3 Implications of the Air Monitoring Results

As reported in Section 1.3.2 of this report, the annually averaged concentrations of Pu-239/240, Am-241, U-233/234, U-235, and U-238 measured at the air sampling network have been compared to the compliance levels listed in Table 2 of Appendix E to 40 CFR 61. The maximum average concentration of each isotope, as shown in Table 5−1, ranges from 0.03 percent (Am and Pu) to less than 0.4 percent (U-234 and U-238) of the corresponding concentrations listed in Table 2 of Appendix E to 40 CFR 61. In addition, the fractional sum of all isotopes at the sampler location showing the highest concentrations in the 12-month period (October 2005−September 2006) was determined to be approximately 0.008. This corresponds to an annual dose of 0.08 mrem, or 0.8 percent of the 10-mrem standard. Had the Site been subject to 40 CFR 61, subpart H during the reporting period, it would have demonstrated compliance with the standards of that regulation.

Figure 5–2 shows monthly monitoring results for the period from October 2005 through September 2006 at the three sampling locations. The total airborne concentrations of radionuclides are presented as percentages of the allowable dose rate prescribed under 40 CFR 61, Subpart H for all isotopes combined. The total height of each bar in Figure 5–2 is the fractional sum of isotope concentrations expressed as a percentage. Sampler locations have been shown in Figure 5–1.

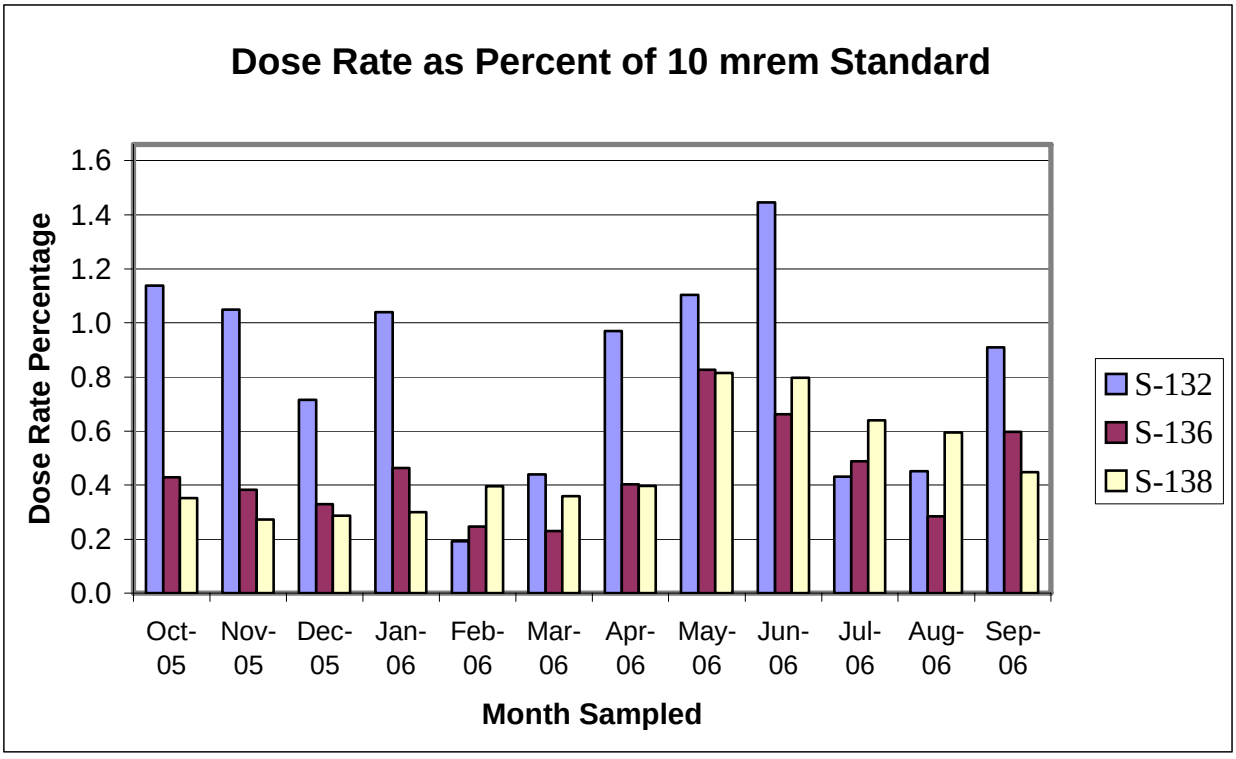

Figure 5–2. Dose Rate Estimated from Environmental Measurements of Airborne Radionuclides Sampled from October 2005 through September 2006, by Month

During this reporting period, the maximum measured radionuclide levels occurred to the west-northwest of the Site, at sampler S-132. This is the same sampler that had the highest measured annual-averaged radionuclide concentrations in 1998, 1999, 2000, 2001, and 2002. (In 2003 and 2004, sampler S-254, located across open space north of the Site along a dirt road that has seen increased traffic volumes due to local development, had the highest measured radionuclide concentrations among the compliance samplers being used at that time. In 2005, while active, sampler S-254 still showed higher measured concentrations of U than any other compliance sampler, most likely related to local dust sources combined with naturally occurring U isotopes in the soils in this part of the Front Range. Samples from that location, S-254, were not representative of Rocky Flats emissions.) The highest overall location in 2005 is not estimated, since the compliance network was not active for the entire year.

Naturally occurring U isotopes were the greatest contributors to airborne radionuclide levels at all monitoring locations in CY 2006. The monthly contribution of U-233/234 and U-238 activity ranged from 51 percent to approximately 100 percent of the measured dose rate, and for the year contributed around 94 percent of the dose rate.

The implications of the grass fire that occurred on April 2, 2006, were analyzed and presented in some detail at the time immediately following that event and are not presented in this annual report. The basic conclusion from that analysis, including the results of both modeling and sampling, was that the increase in airborne radionuclide emissions from the area involved was negligible and not detectable in the sampling network.

Table 5−2 also presents the annually averaged measured concentrations of Pu-239/240 and Am-241 at the three sampling locations. These two isotopes, the major constituents of the weapons-grade Pu processed at the Site, were reported by the laboratory at activities less than the required laboratory detection limit in nearly all samples. The laboratory-required detection limits were specified to assure that these isotopes would be measurable at airborne concentrations less than 1 percent of the Appendix E, Table 2 limits.

The estimated dose rate for this reporting period at the sampling location indicating the highest dose rate can be compared with the 10-mrem dose limit and with data from prior years. Figure 5–3 shows these results. As noted previously, the annually averaged dose rate at the critical receptor location in the current reporting period is 0.82 percent of the standard, based on the 12-month average. The results for all years are presented as a percentage of the 10 mrem dose limit.

The progressive increase in emissions over the 8-year period prior to physical completion was consistent with the continually increasing levels of soil disturbance and demolition activity occurring over the same period. The rapidly reduced emissions evident in the results for the CY 2006 reporting period demonstrate the effects of the reduced activities and diminished sources on the Site following its closure.

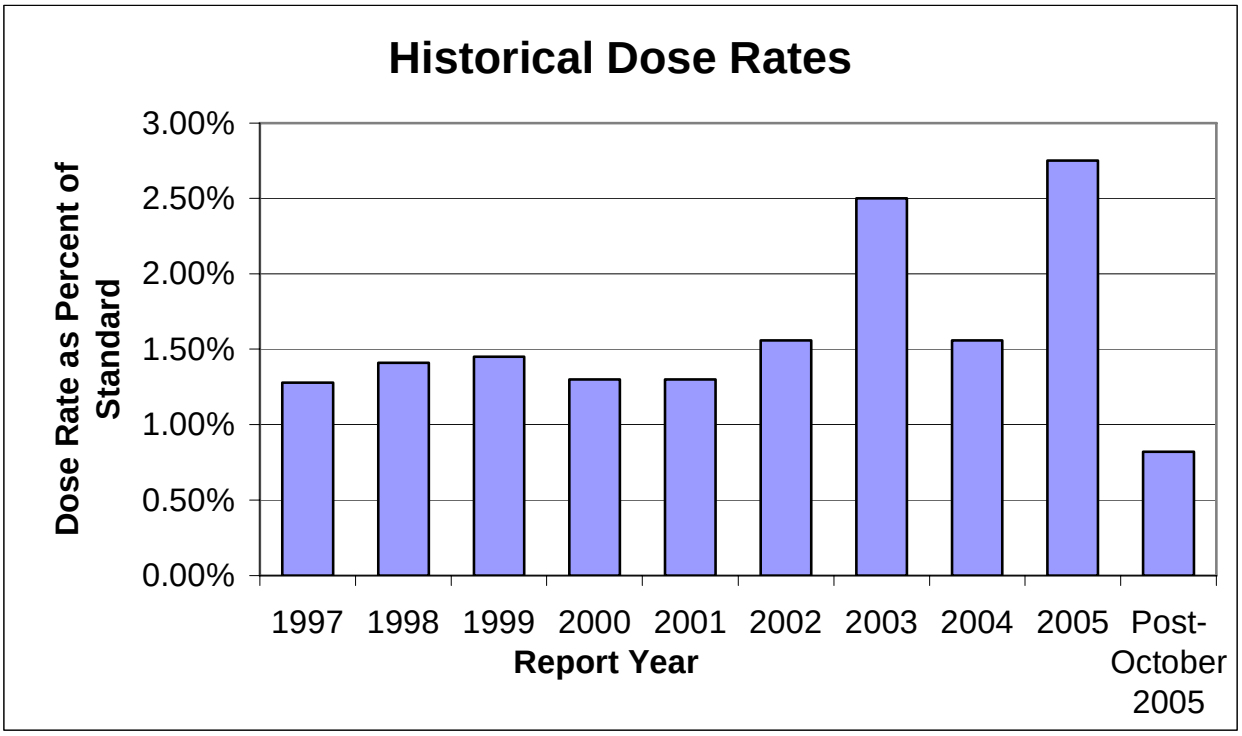

Figure 5–3. Annually Averaged Concentrations as a Fraction of the 10 mrem Standard for the Years Leading to Site Closure

End of current text